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Safety and Security

Transports Canada
Sécurité et sûreté

Child Restraint Research

Transport Canada

Transportation Development Centre

Aastra Aerospace

Cabin Safety Standards





Project Evolution



Joint FAA/TC testing in 1989

- Recommendation: R & D dedicated to the design of a restraint system for infants and small children traveling in aircraft be conducted without delay.







Objective was to determine the feasibility of developing a CRS which meets the needs of the users, the airline industry, and the regulators.





Drivers

-  Request for approval of “Belly Belt”
-  Operational problems associated with CRS
-  Search for innovative solution
-  Child Safety System - not necessarily a “seat”





Project Initiation

RFP

- Results - No CRS manufacturers
- Successful bidder - AASTRA
- Aerospace Engineering - since evolved into a telecommunications company





Design Decisions

 **Who provides?**

 **What standard to use?**

 **Modal vs Multi-modal**

 **Aviation Standards or Automotive Standards - for materials & machining**


 **Certification - Self certified or approved?**





Standard

 **CMVSS 213 used in absence of aviation specific standard**

 **CMVSS 213 similar to FMVSS 213 except for more conservative head excursion limit of 28.4 inches (720 mm) vs 32 inches (813 mm) - generates a requirement for a top tether**

 **Additional requirements for aviation environment**





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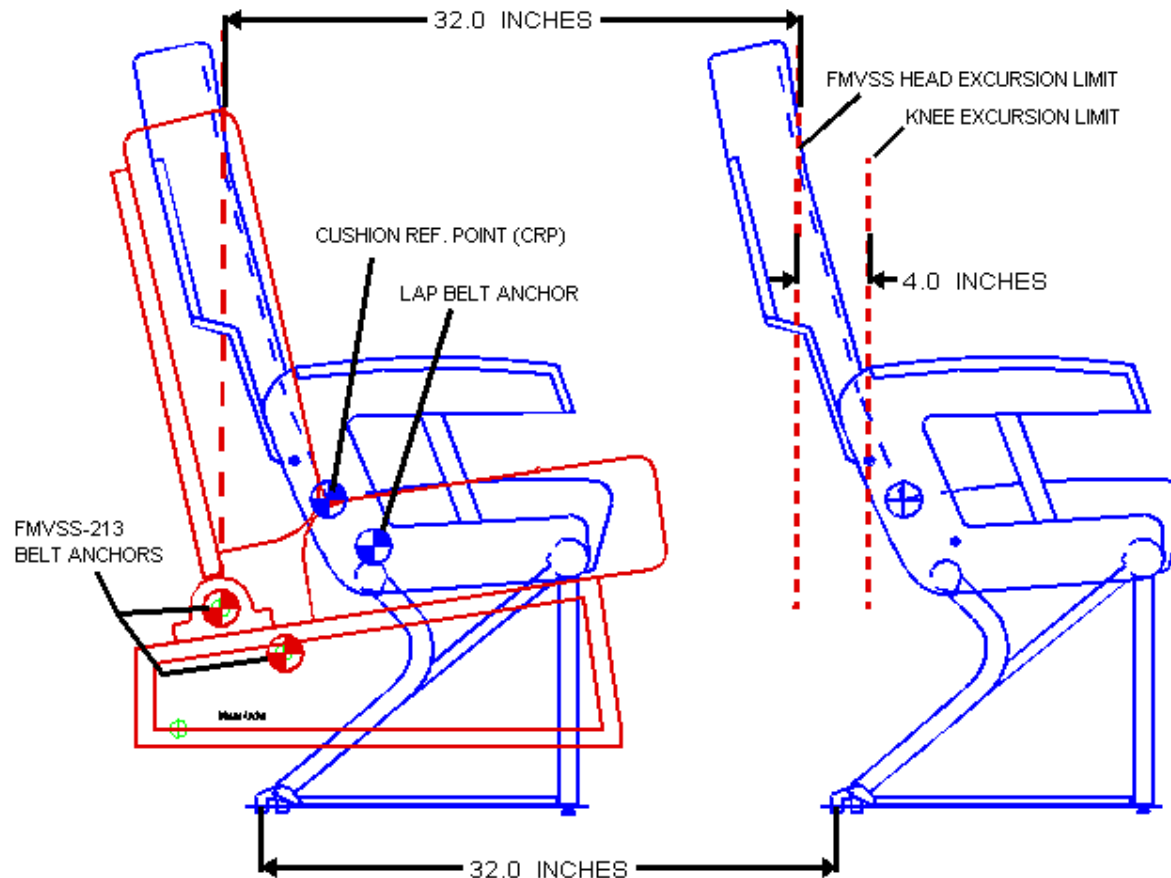
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Fit Function eFFectiveness



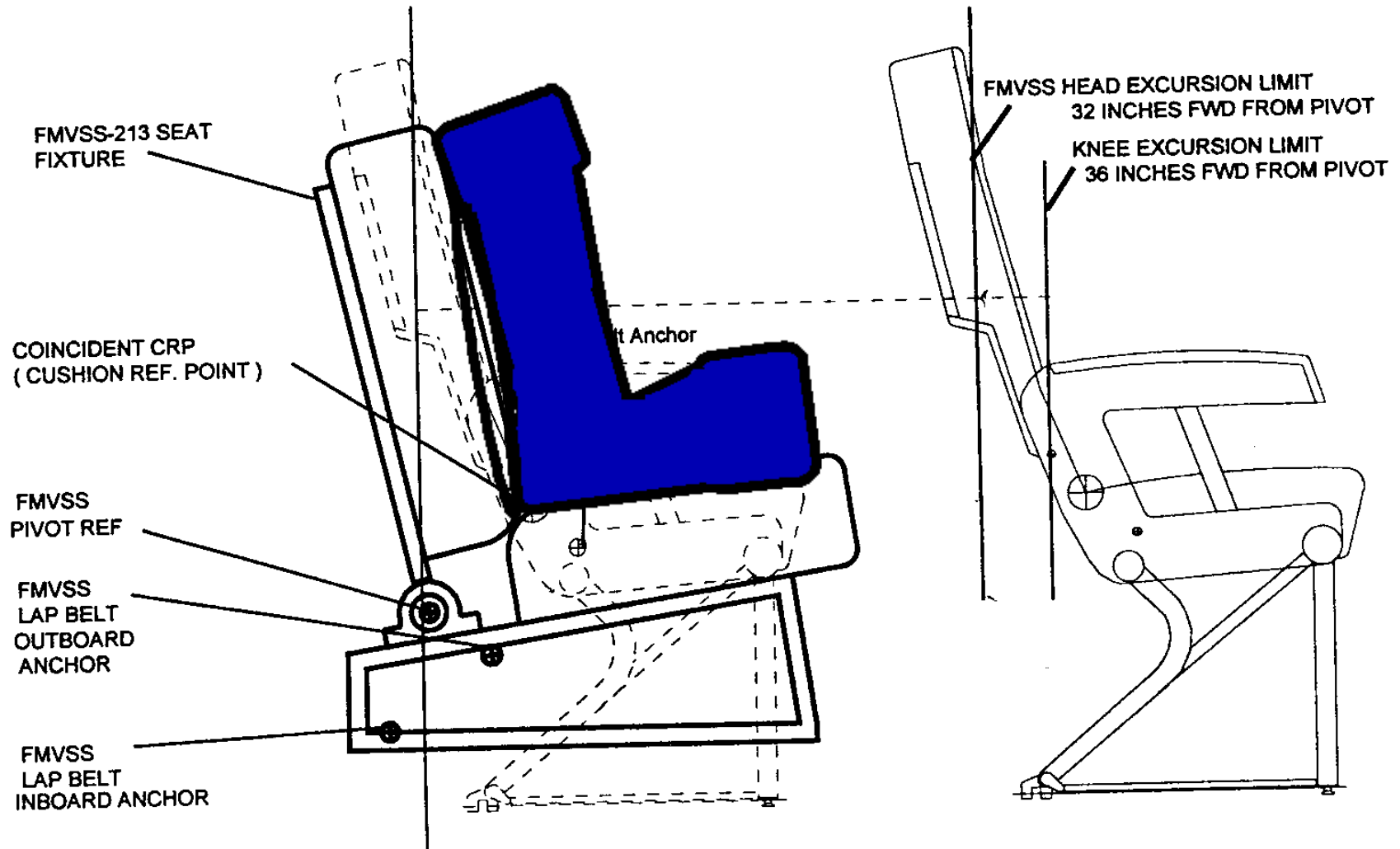


Current Performance Criteria per FMVSS-213



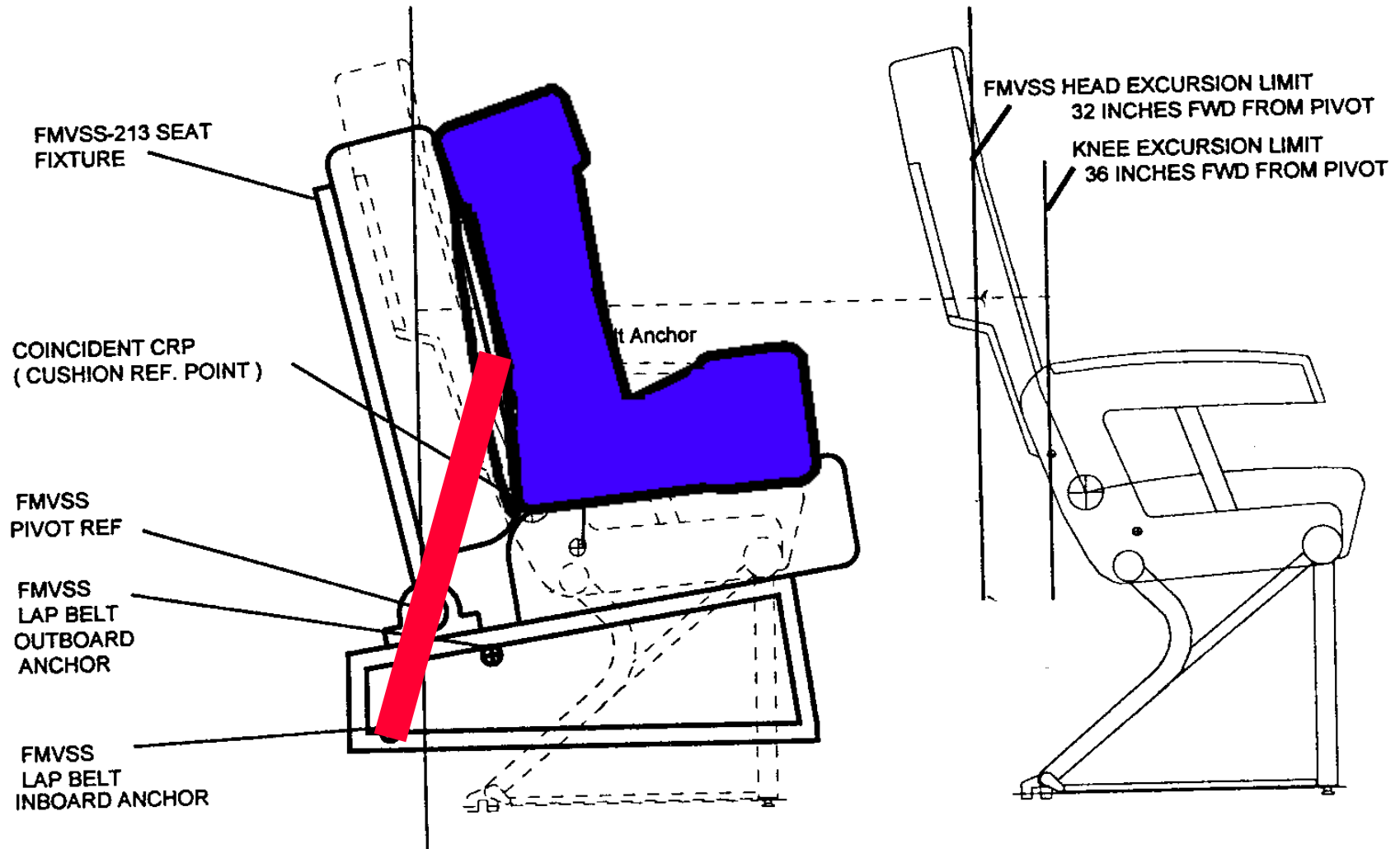


32 INCH SEAT PITCH INSTALLATION



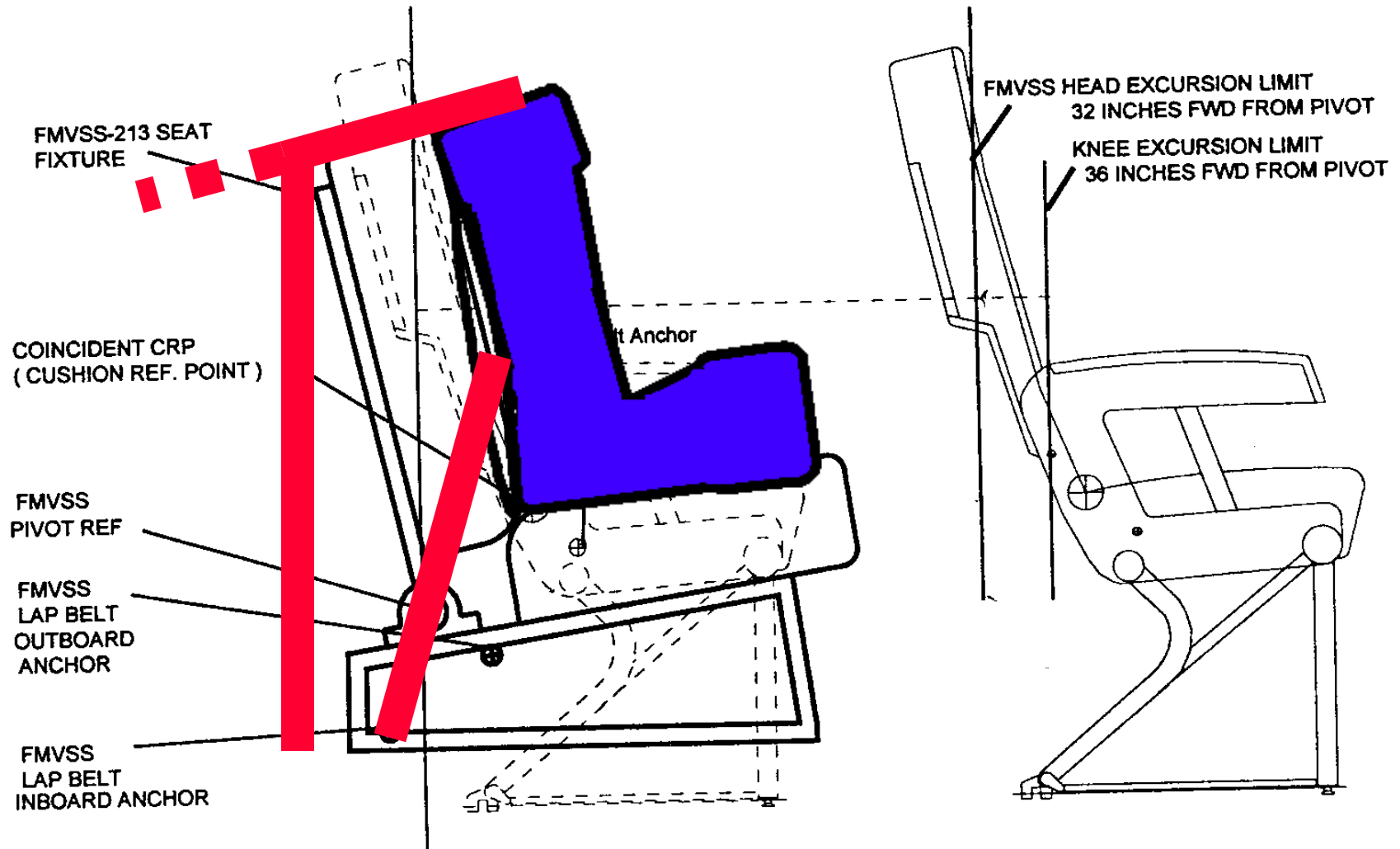


32 INCH SEAT PITCH INSTALLATION



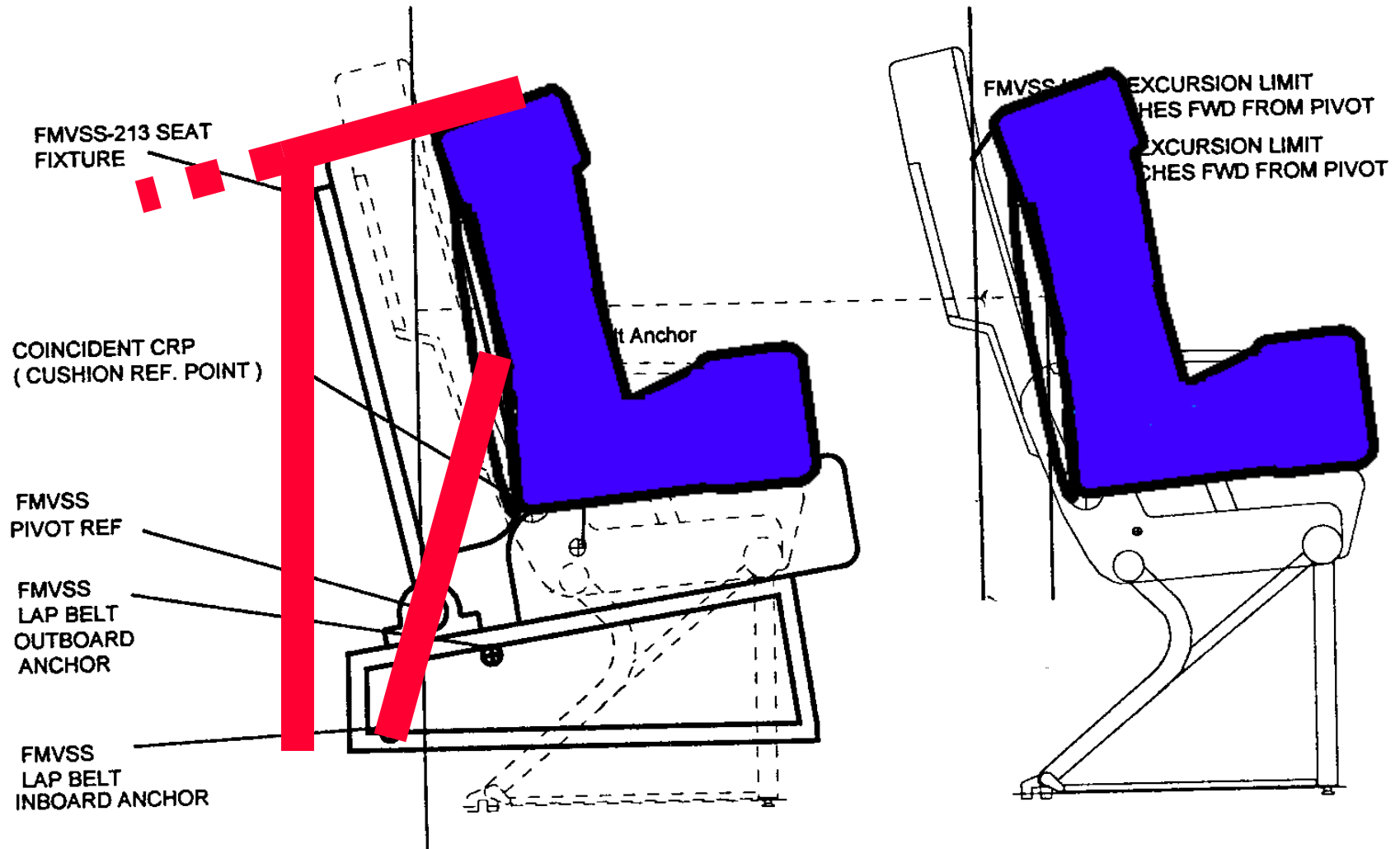


32 INCH SEAT PITCH INSTALLATION



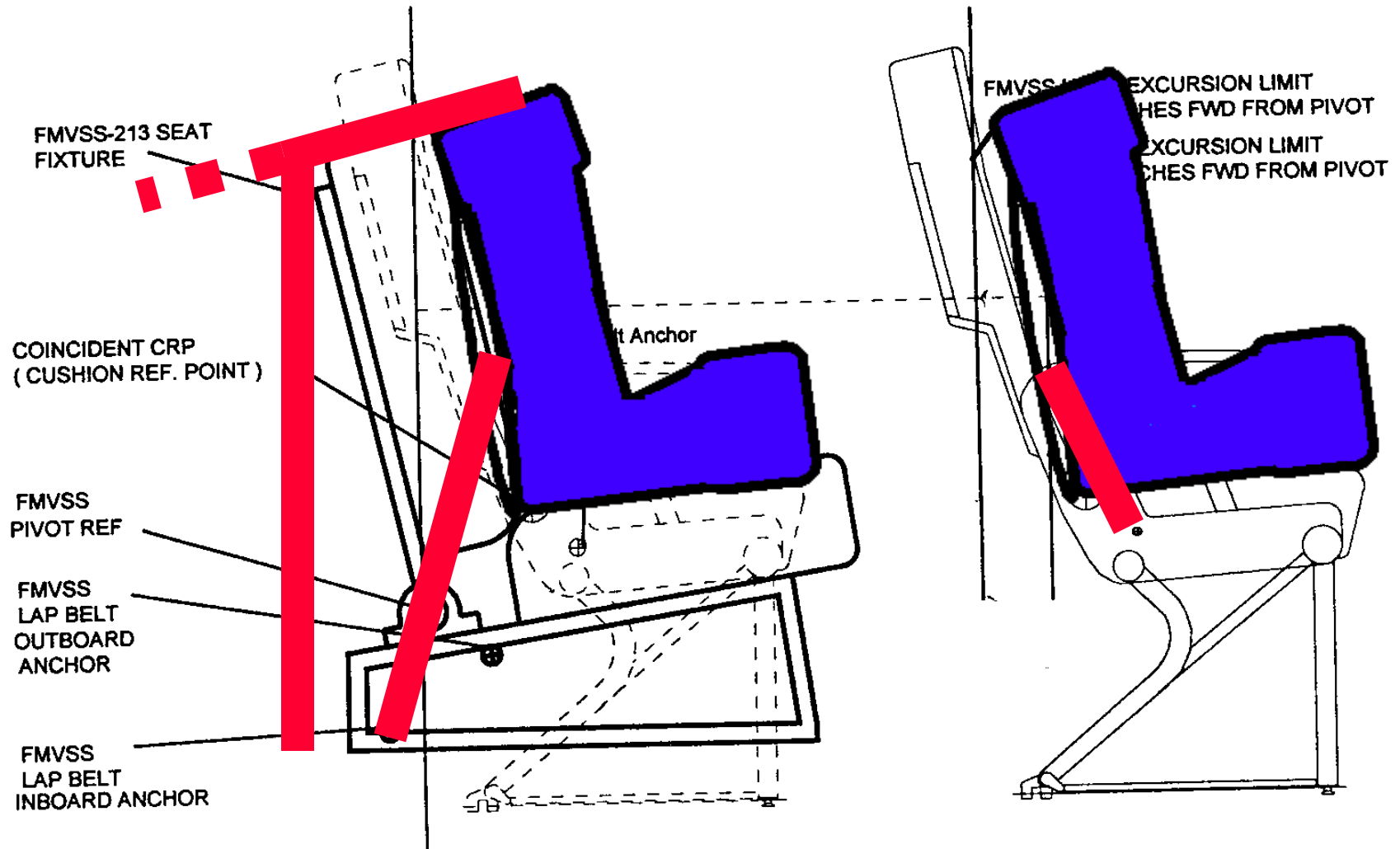


32 INCH SEAT PITCH INSTALLATION



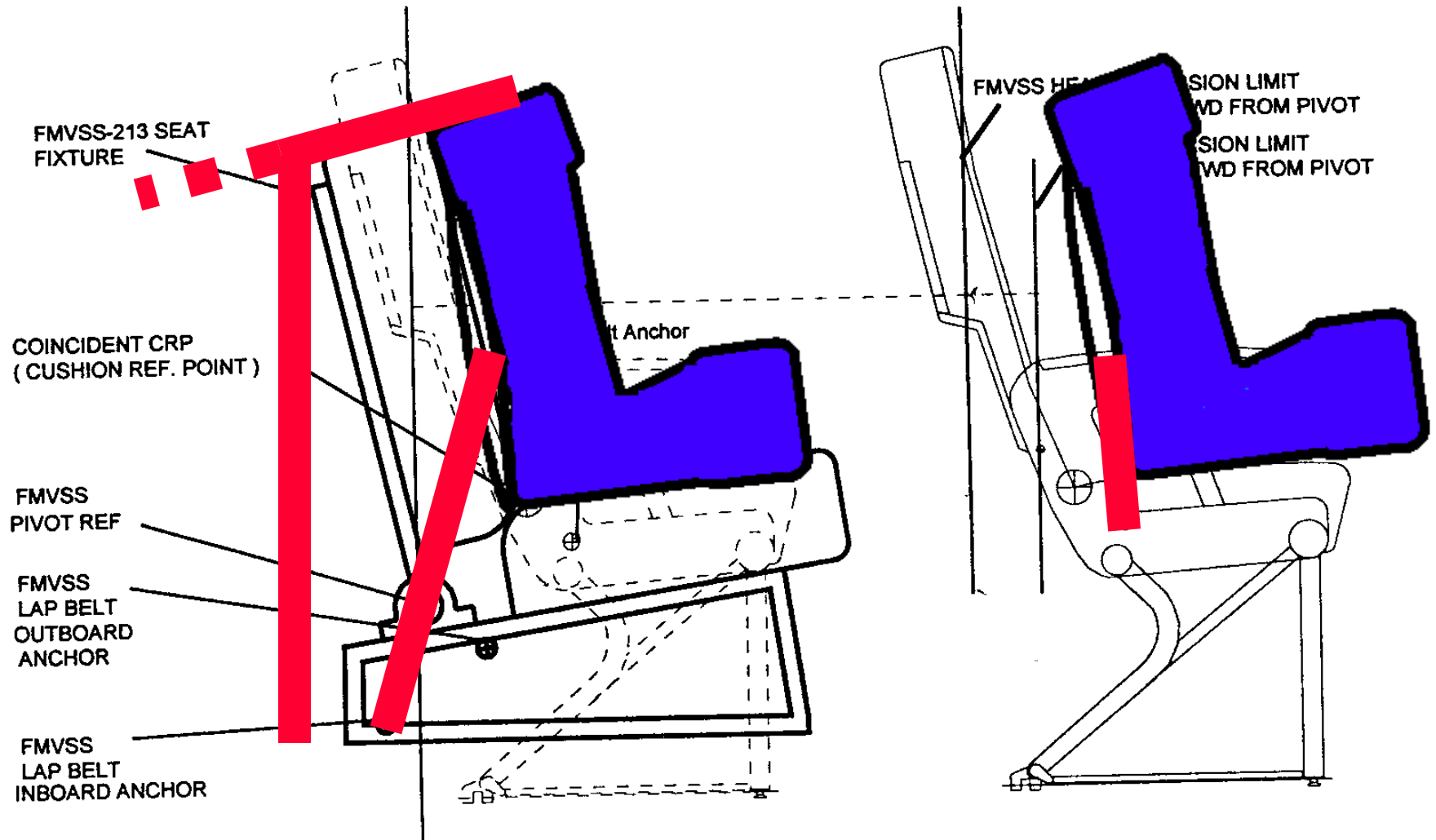


32 INCH SEAT PITCH INSTALLATION



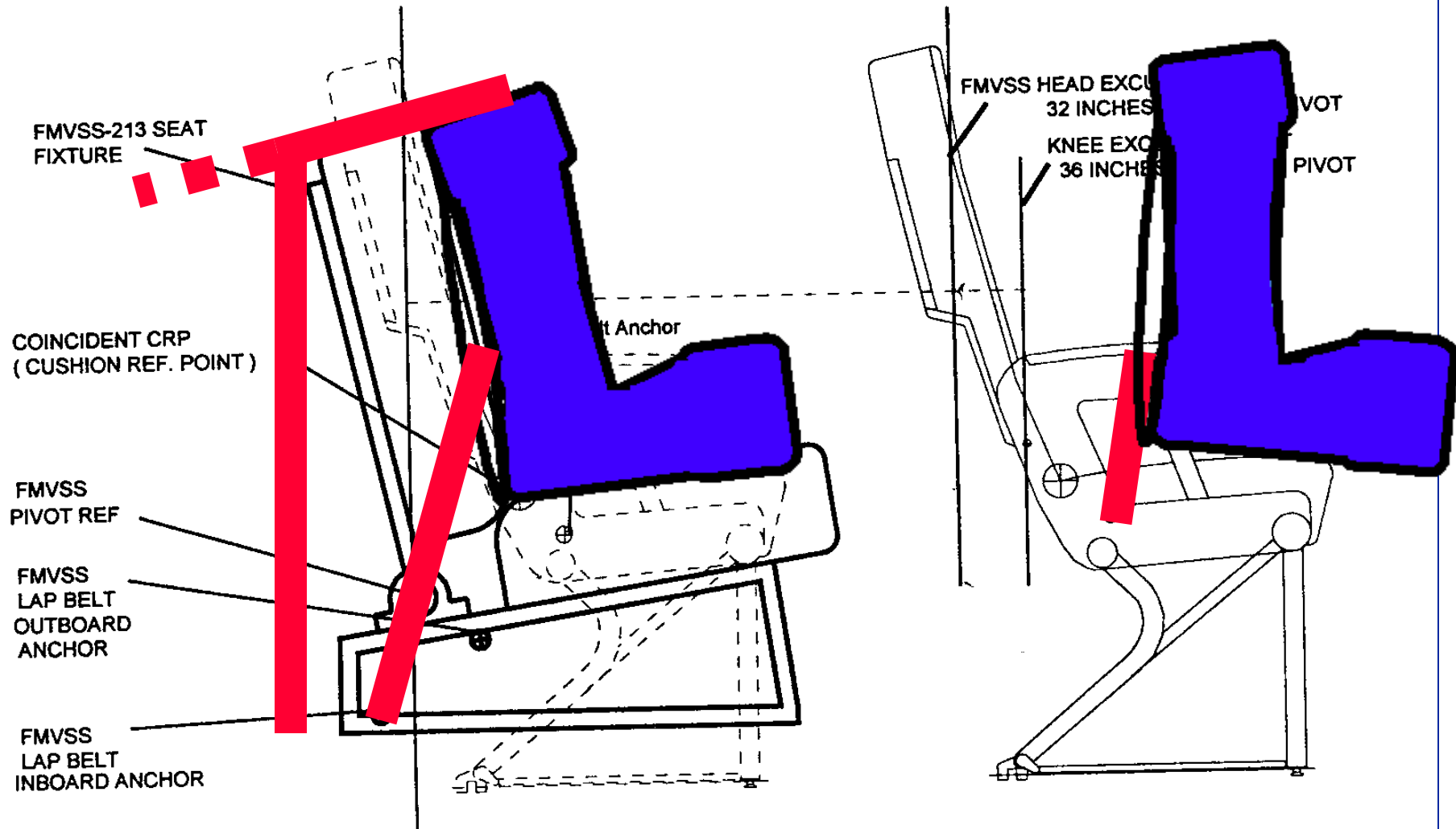


32 INCH SEAT PITCH INSTALLATION



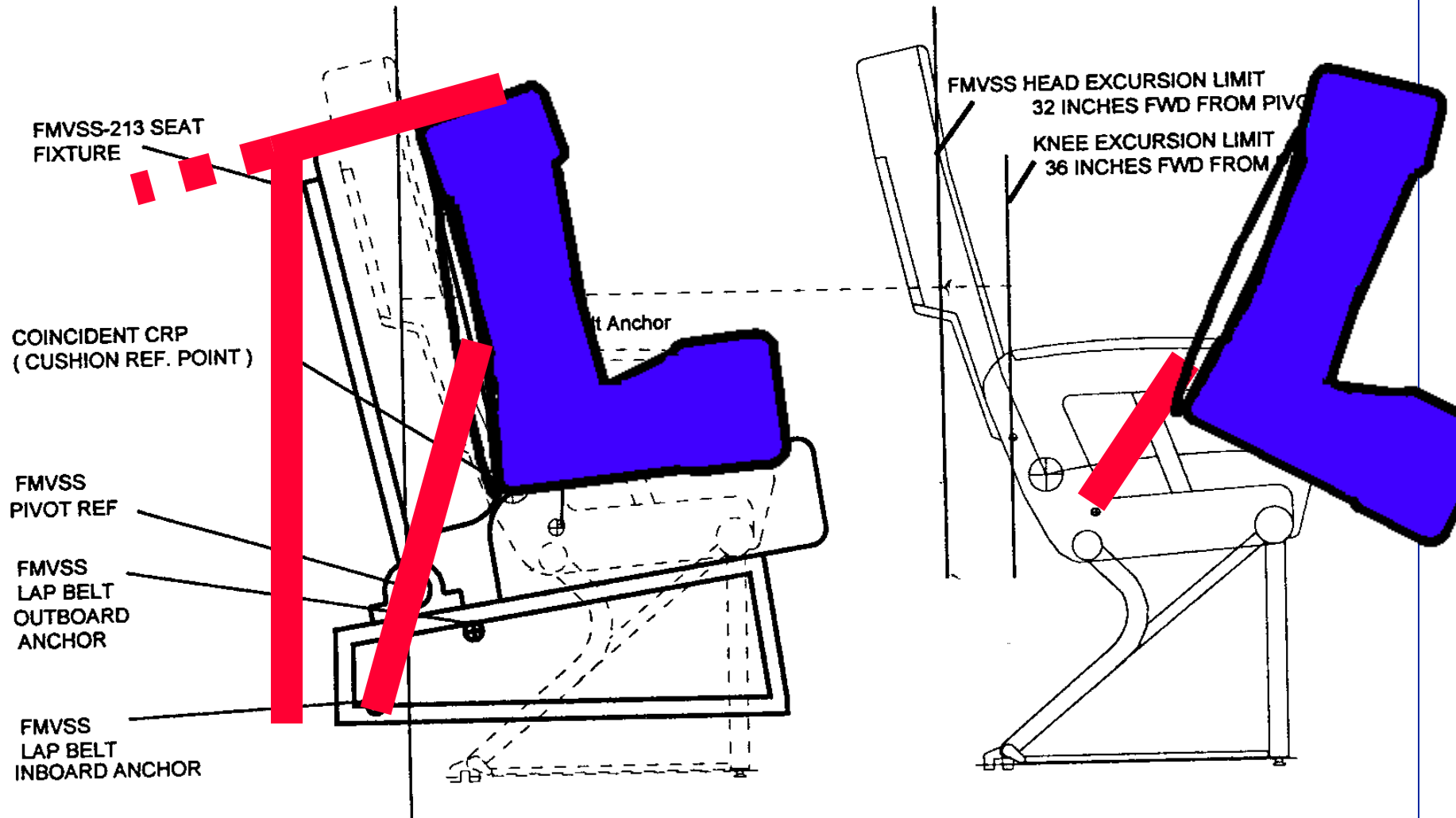


32 INCH SEAT PITCH INSTALLATION





32 INCH SEAT PITCH INSTALLATION





AVIATION VS AUTOMOTIVE



WIDTH BETWEEN ARMRESTS



BASE - DIMENSIONS



SEAT PITCH



INSTALLATION METHODS



INSTALLATION FREQUENCY










ANCHORAGE POINTS









Additional Requirements

-  **Simple and obvious to install in a/c**
-  **Easy and quick to adjust**
-  **Compact - minimize stowage space**
-  **Easy to maintain**
-  **Compatible with aircraft seats**
-  **Effective in aviation environment**
-  **Must provide occupant protection**





PROJECT EVOLUTION

-  **MODULAR FLOTATION CONCEPT**
-  **NON-FLOATING, FOLDING SYSTEM,
(MARK I PROTOTYPE)**
-  **OPTIMIZED FOLDING SYSTEM
(MARK II PROTOTYPE, ACSS)**
-  **MARK II A**

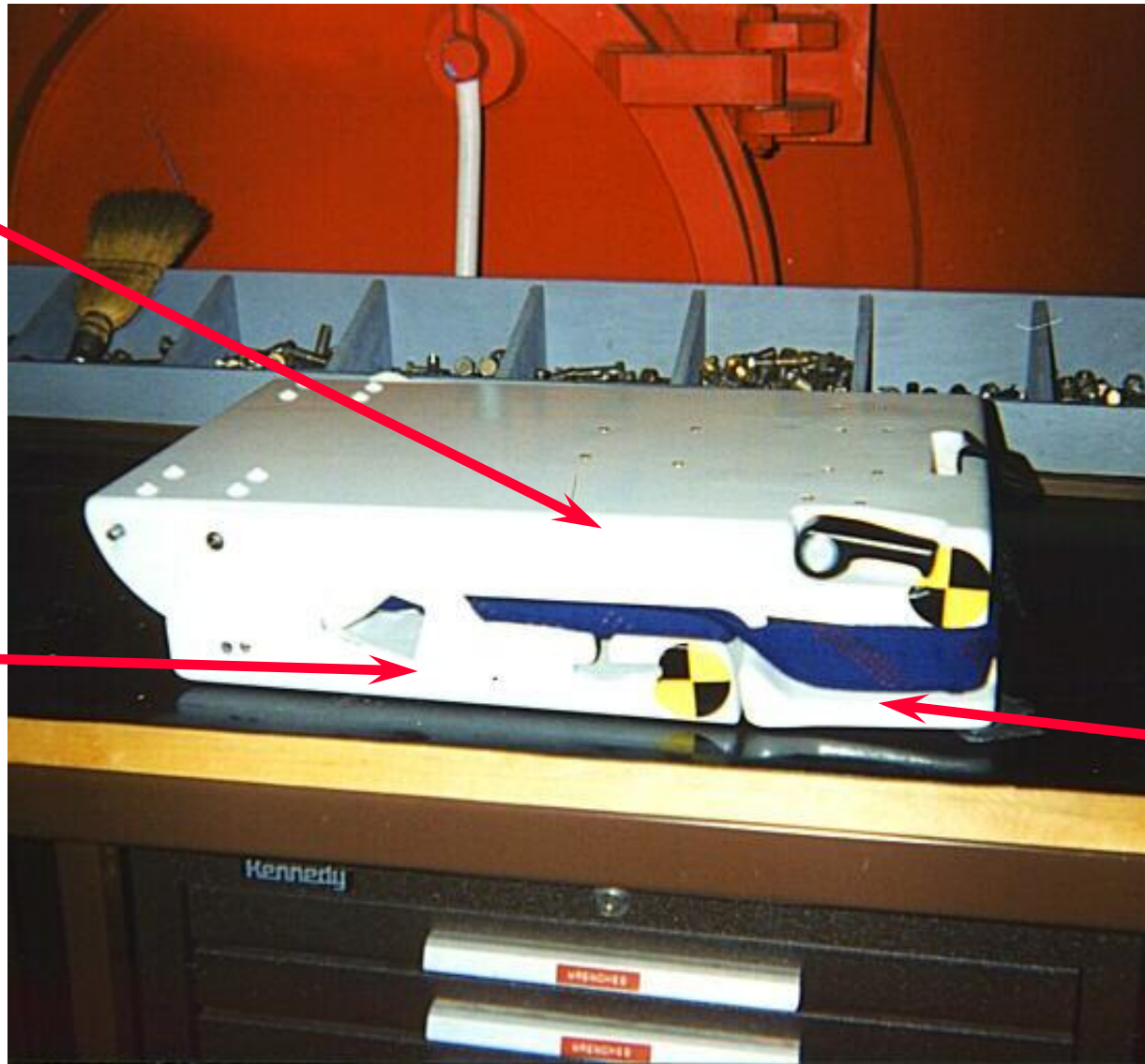


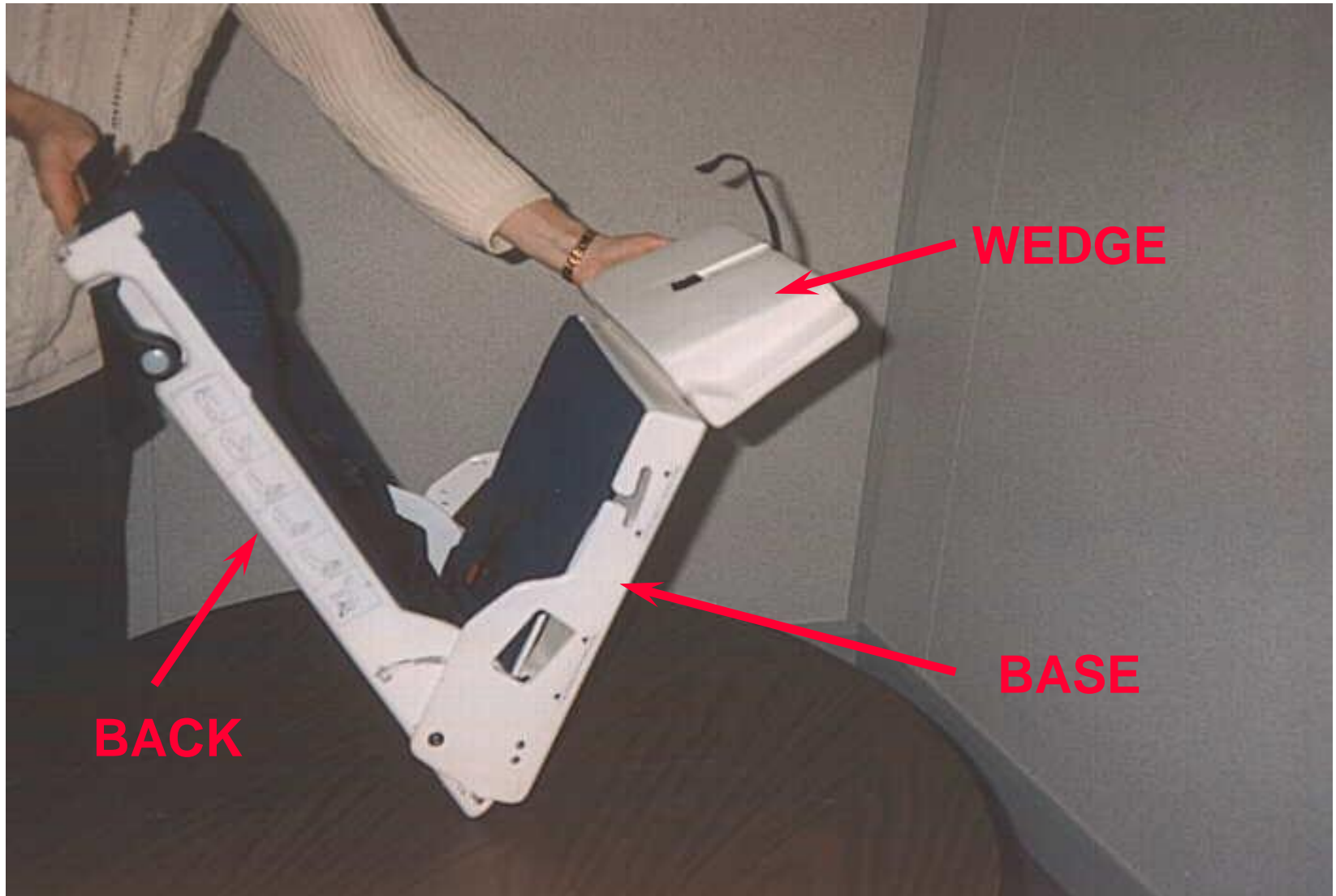


BACK

BASE

WEDGE







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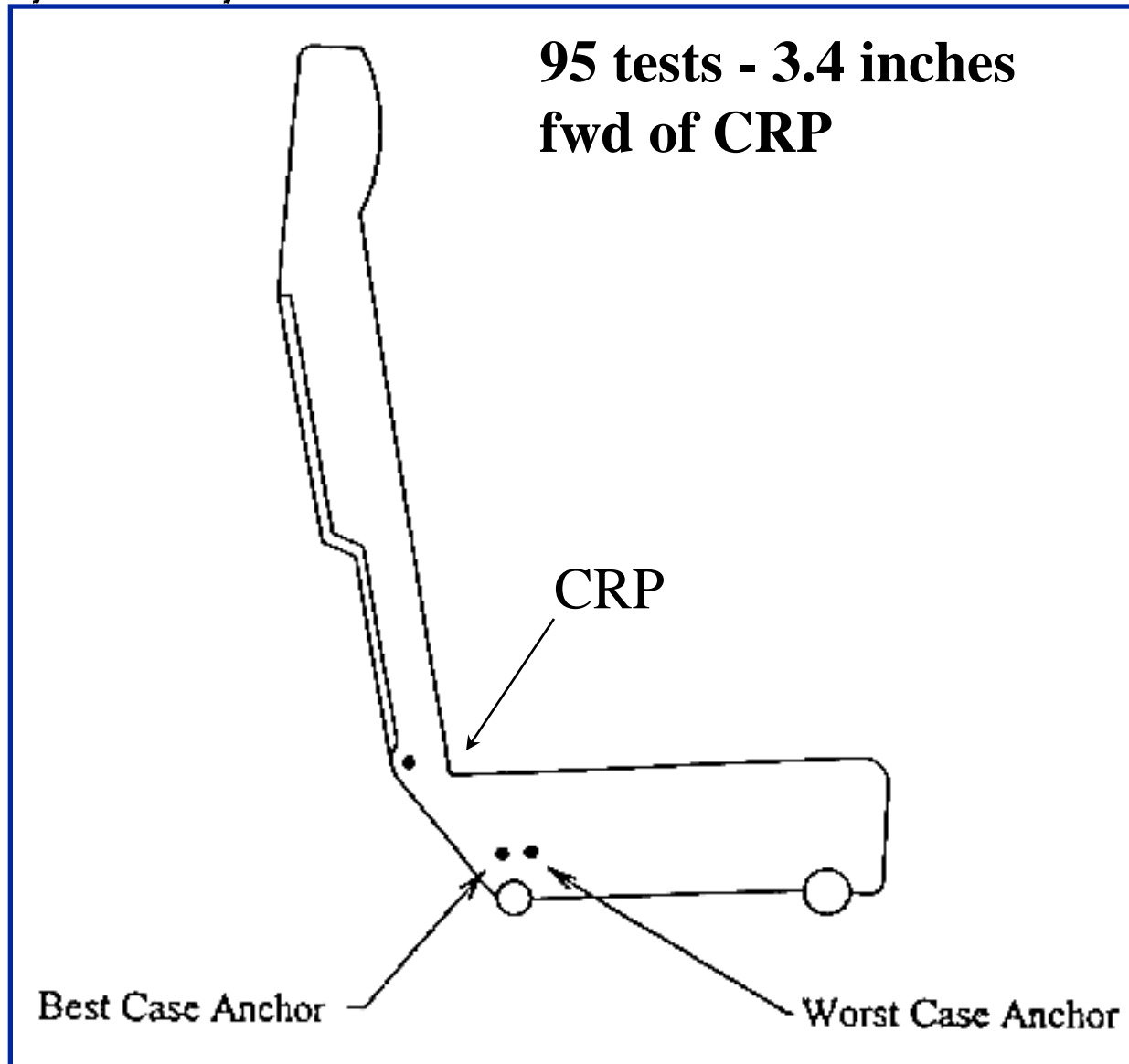
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DYNAMIC TESTS

CHILD TEST RESULTS (CMVSS 213)

CRITERION	MAXIMUM PERMISSIBLE VALUE	ACSS TEST
MAX. CHEST ACCEL.	60 g's over 3 msec	45 g's : passed
HEAD EXCURSION LIMIT	28.4"	22.1" : passed
HEAD INJURY CRITERION (HIC)	1000	374 : passed

INFANT TEST RESULTS (CMVSS 213.1)

CRITERION	REQUIREMENT	ACSS TEST
HEAD EXCURSION LIMITS	Forwardmost Point	passed
	Readwardmost Point	passed
ROTATION LIMIT	Carrier Seatback angle: < 70 degrees	passed (43 degrees)
STRUCTURAL INTEGRITY AND SAFETY	No injurious surfaces	passed





DYNAMIC TESTS

FAA TEST CASES

TEST NO.	1	2	3	4	5
CAMI Run No.	A95059	A95060	A95061	A95062	A95063
Single Row	Child, BCA	Child, WCA	n/a	Child. WCA	n/a
Double Row					
Row 1	n/a	n/a	Infant, BCA	n/a	empty
Row 2			Child, WCA		Infant, BCA





DYNAMIC TEST RESULTS

Infant Test Results (CAMI)

Test No:	A95061	A95063
CRITERION:		
No excessive forward translation or rotation	pass	pass
Secure restraint of ATD	pass	pass
Protection of ATD's head	pass	pass
Maintain structural integrity	pass	pass





DYNAMIC TESTS

Child Test Results (CAMI)

Test No.	A95059	A95060	A95061	A95062
CRITERION				
Prevent excessive head excursion	pass	pass	pass	pass
Chest accel.: (pass: < 60 g's)	29.4 pass	33.3 pass	31.1 pass	data not available
HIC : (pass: <1000)	298.7 pass	373.3 pass	425.1 pass	data not available
Secure restraint of ATD	pass	pass	pass	pass
Maintain structural integrity	pass	pass	pass	pass





1997 CAMI TESTS MKIIA



TEST SERIES

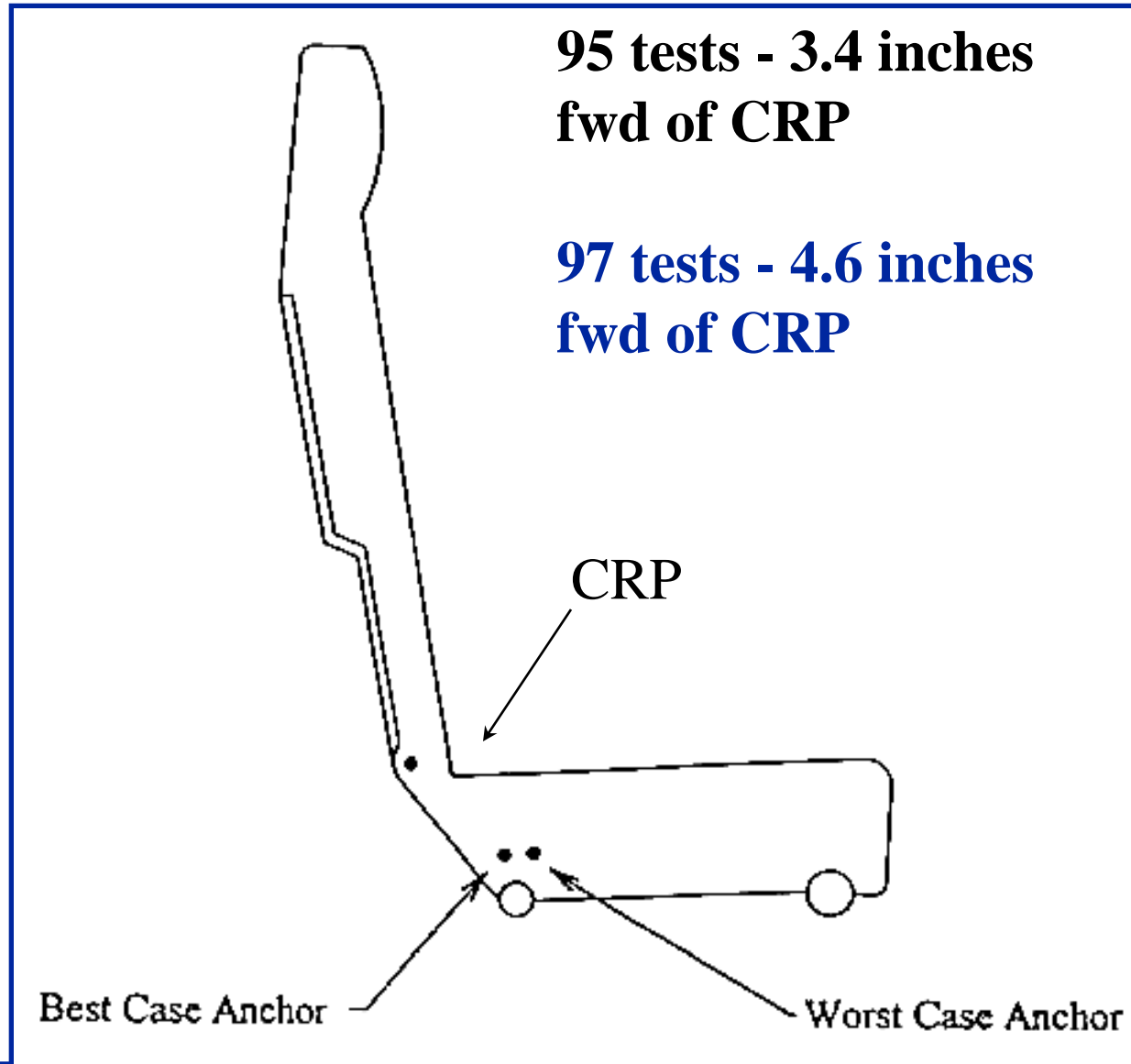
- FWD FACING - 3 RUNS
- AFT FACING - 2 RUNS



DIFFERENCES IN TEST PROCEDURE

- SEAT BACK POSITIONING
- TYPES OF HARNESSSES
- ANCHOR POINTS !!!

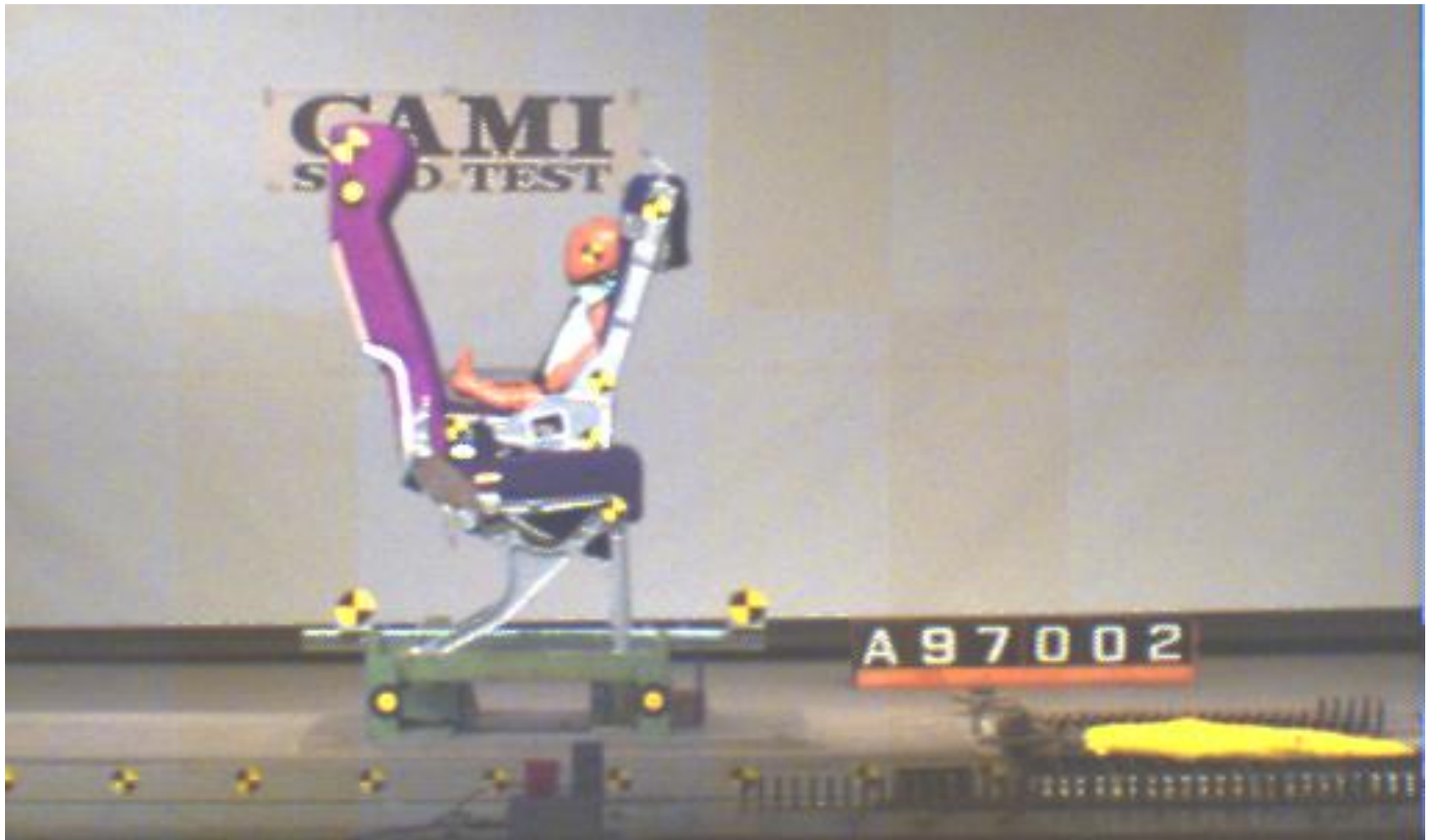






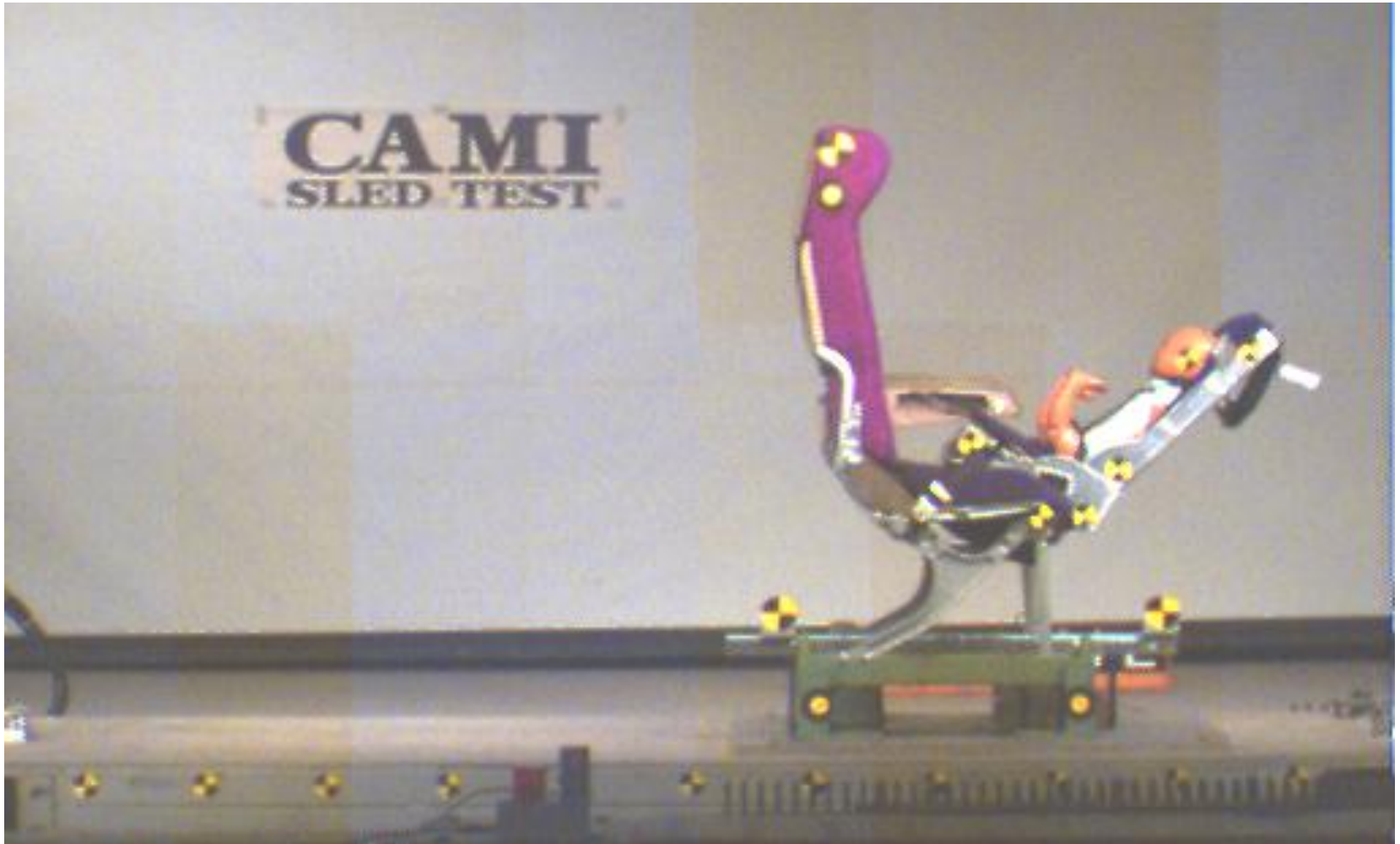
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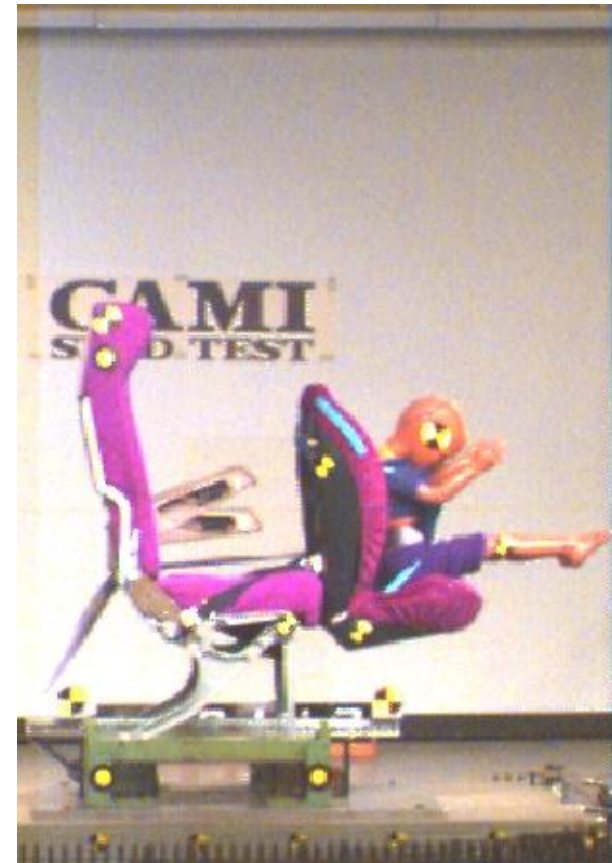








Example of poor interface between CRS and passenger seat





1998 CAMI TESTS - MKIIA PRODUCTION VERSION



TEST SERIES

- FWD FACING
- AFT FACING



DIFFERENCES IN TEST PROCEDURE

- PAX SEAT BACK - PRE-TENSIONING







RESULTS



Objective was to determine the feasibility of developing a CRS which meets the needs of the users, the airline industry, and the regulators



Preliminary results indicate the objective is feasible







Where to from here?





STATUS

-  Intellectual Property rights recovered
-  25 devices manufactured
-  Concurrent activity - development of a standard suitable for aviation - currently a SAE S-9 activity - AS5276
-  Validation testing for AS 5276
modifications to CMVSS test bench



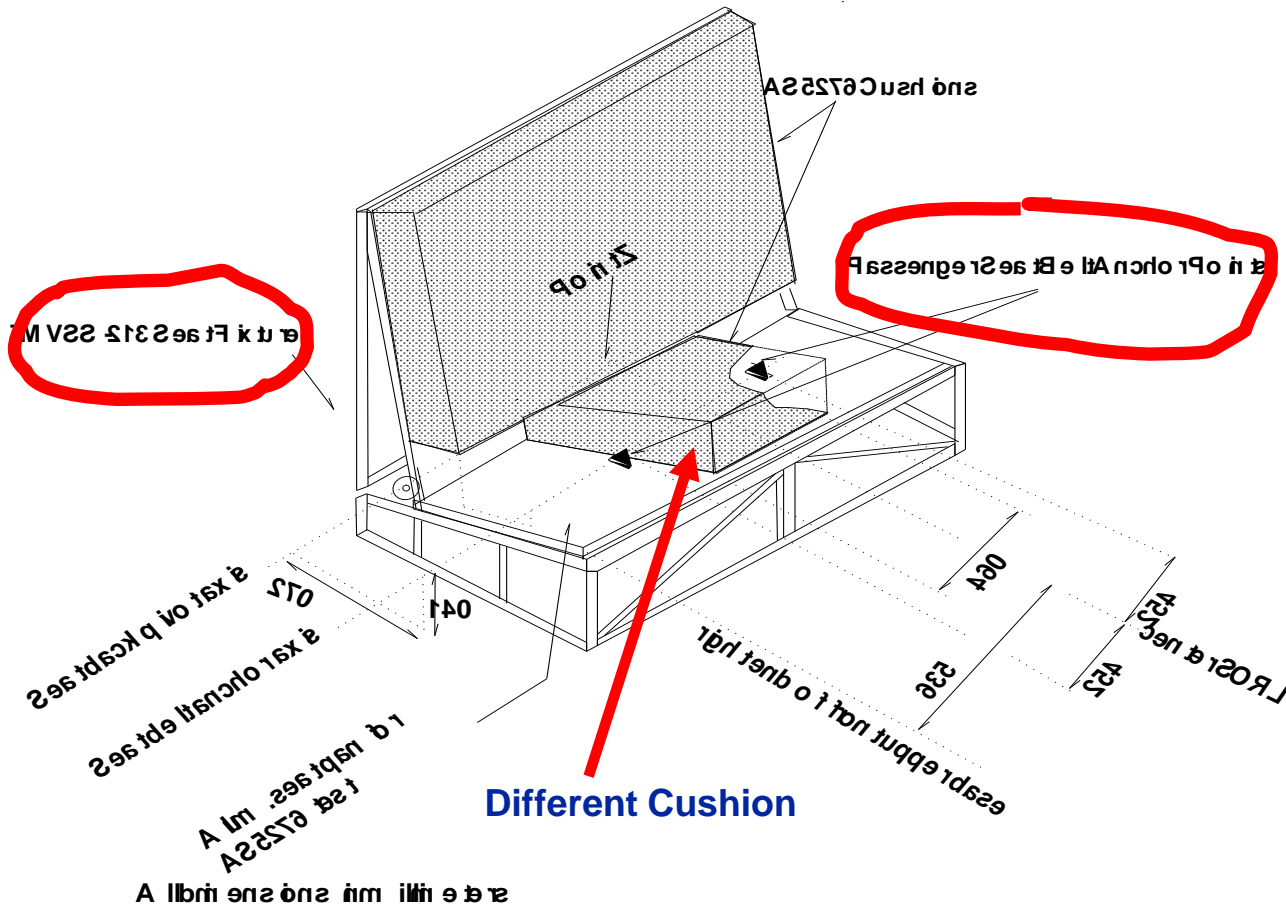


Proposed New SAE Aerospace Standard (AS 5276A ... in progress)

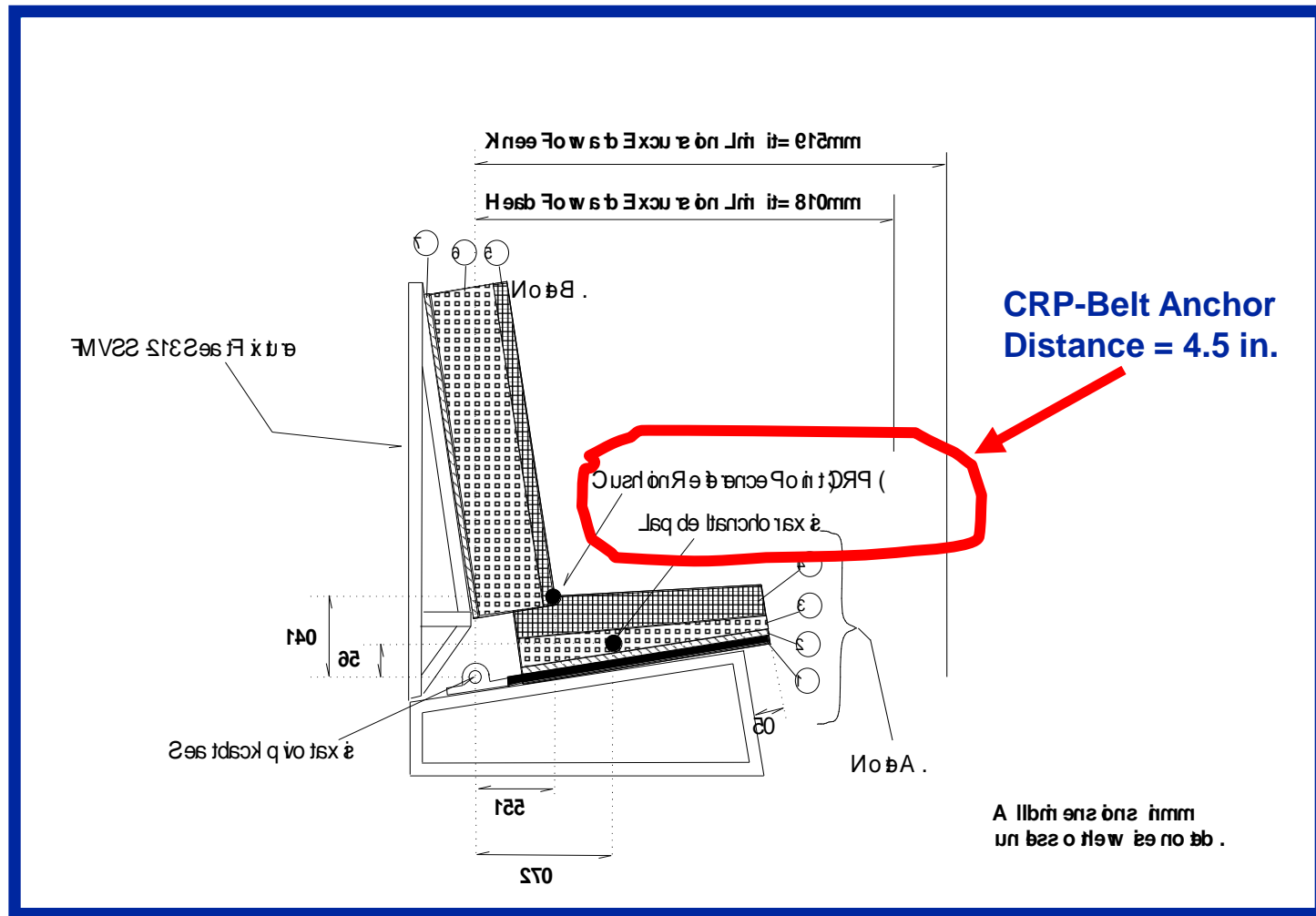
- SAE S9 Committee developing an AS for child restraints used with transport airplane passenger seats.
- Based on test procedures and methods of FMVSS-213, with modifications to test fixtures.
- Specifies a 16g test condition, airplane type belts and belt anchor locations.
- Pass/fail criteria to limit head excursion to 26 inches forward of seat CRP.



Proposed SAE AS Test Method ...



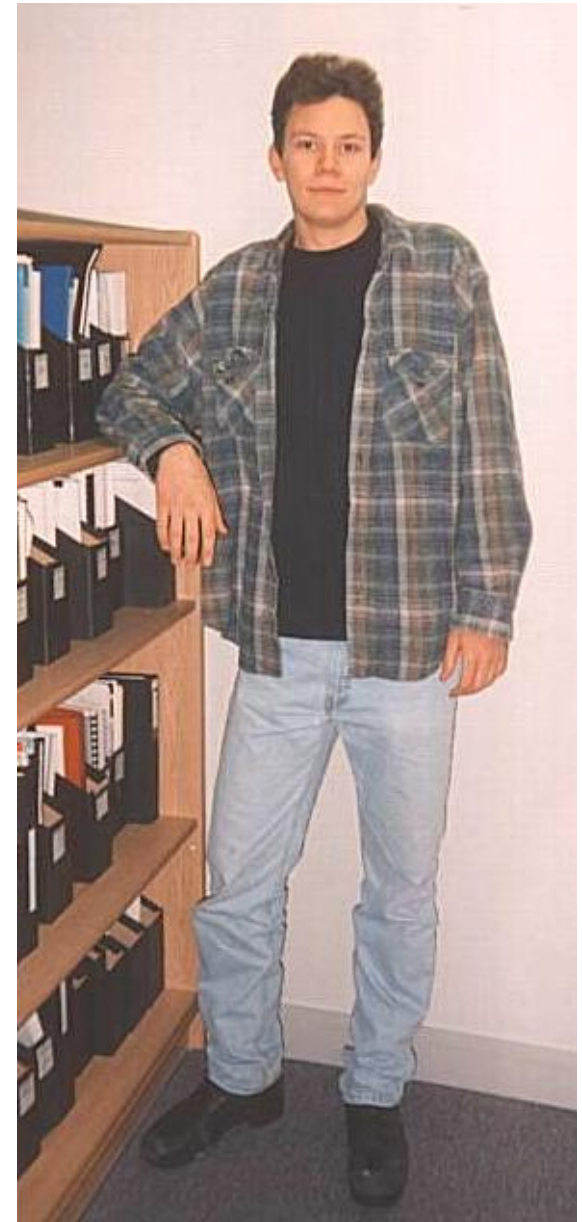
Proposed SAE AS Test Method ...





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